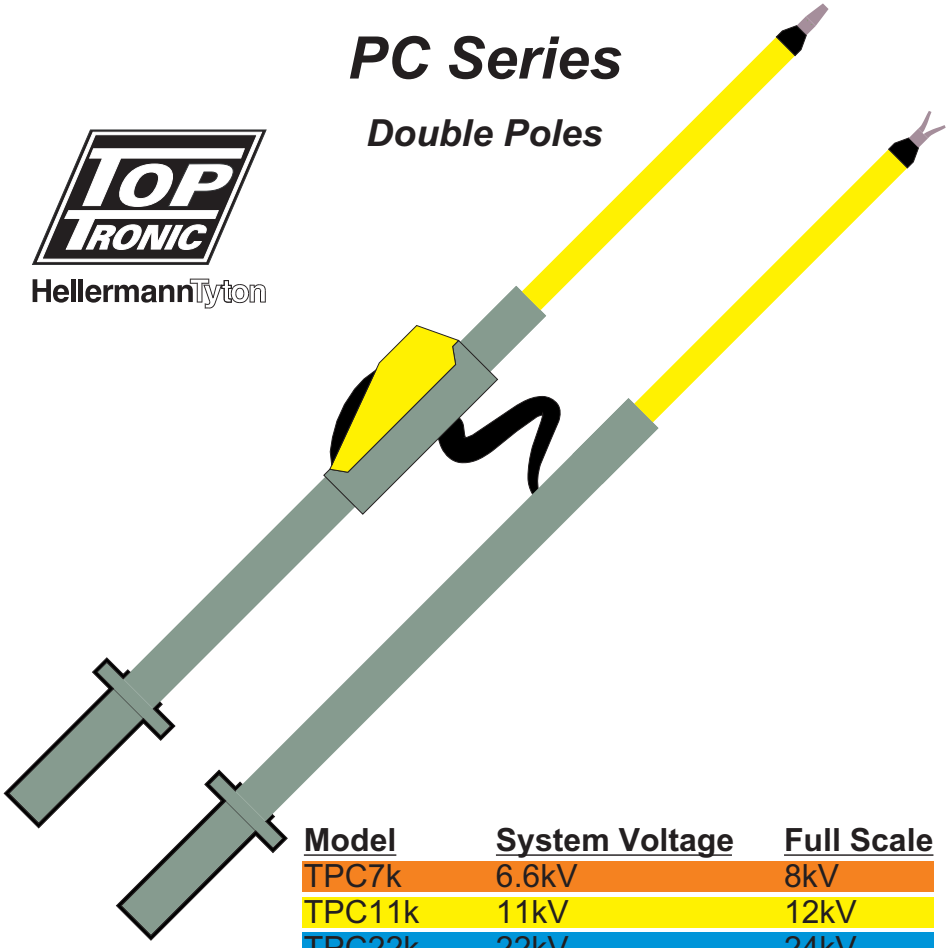
USER'S MANUAL
for
HIGH VOLTAGE PHASE COMPARATORS

PC Series

Double Poles

TOP TRONIC
HellermannTyton



Model	System Voltage	Full Scale
TPC7k	6.6kV	8kV
TPC11k	11kV	12kV
TPC22k	22kV	24kV
TPC33k	33kV	36kV
TPC44k	44kV	48kV

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SAFETY RULES

- Only Personnel who are fully **trained** in the use of High Voltage Phase Comparators should use this equipment.
- Be aware that the system that it will be used on are powered from high voltages which are **lethal**.
- Before use, ensure that the Phase Comparators and any accessories are **clean**, free from cracks or deep scores, and are properly secured together.
- Only the proper rated Phase Comparators must be used. Ensure that the Phase Comparator is **properly rated for the voltage** of the system under test.
- **Test** the operation of **the Phase Comparator before and after** each test.
- Do not allow any part of the Phase Comparator except the contact electrodes to come in contact with energized or earthed items.
- **Safe Working distance** must always be observed.
- **Safety** insulated **Gloves and protective clothing** and glasses must be wear when using the Phase comparator.
- The Phase Comparator must only be **handled by one person only.**
- Do **not** insert the Phase Comparator **beyond its limit mark** into the apparatus under test. **The Limit mark is the red band**.
- The Phase Comparator should **not be used as a synchronising Device or a voltage detector**.
- The Interconnecting **lead/cord must not** be allowed to **come within** 100mm (**10cm**) **of the** hand guard and must not be touched while testing.
- Before using the Phase Comparator in the testing of factory assembled swtichgear, the **manufacturer of the switchgear must be consulted** as the suitability of the Phase Comparator in such testing.
- **Always check for Phase Presence before testing between Phases. Ensure that voltage is present on both phases before testing between phases.**
- The Phase Comparators are not to be subjected to a constant voltage for a period longer than 1 minute in every five minutes.

GENERAL DESCRIPTION

- The range of high Voltage Phase Comparators have been designed to **comply and exceeds** the requirements of **VDE0681Part5**.
- The Phase Comparators are double poles devices which are **used to determine the correct Phase Relationship between two energized conductors of the Same nominal Voltage and Frequency**.
- Models are available to cover systems voltages from **1kV to 44kV** 50/60Hz.
- For other systems voltage, please contact the factory.
- All models may be used indoor and outdoors in **dry weather only.**

PRINCIPLE OF OPERATION

- The PC range of Phase Comparators is a resistive devise which comprise mainly of resistors, a neon and a panel meter. The Phase Comparator draw current from the circuit or source under test.
- The Phase Comparator consist of two inter-connected poles (the master pole with the panel meter and the slave pole).
- The Master pole carries the panel meter with the color coded scale and the integral neon light indicator.
- The color coded scale indicates "in-phase/out-of-phase" band on the scale. (Green = in-phase; Red=out-of-phase).
- The Neon light lit up when the voltage between the poles is greater than ±1.2kV ±1.5kV.
- If two energized conductors are out-of-phase and a contact electrode is touched onto each pole, current will flow between the conductors through the resistors (resistors are inside the fiberglass front end in each pole) in the poles and the interconnecting lead/cord. This will cause the neon to lit and the panel meter's indicator to move into the out-of-phase area (Red).
- If two energized conductors are in-phase and a contact electrode is touched onto each pole, current will not flow between the conductors through the resistors in the poles and the interconnecting lead/cord. This should not cause the neon to lit and the panel meter's indicator to move. The indicator will stay into the in-phase area (Green).
- **Ensure that voltage is present on both phases before testing between phases.**

PROVING THE PHASE COMPARATORS

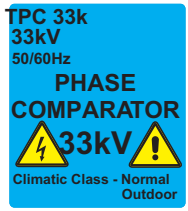
- **Before and after** using a Phase Comparator and accessories, a functional test should be performed on the Phase Comparator as It is to be used on the source or circuit to test.
- A **High Voltage Insulation tester can be used** for this purpose.
- When using a High Voltage Insulation tester, the Phase Comparator will indicate the voltage generated by that H.V. Insulation tester.
- Please note that H.V. Insulation testers are generating DC voltage and have polarity.
- The PC range of Phase Comparators are using a ½ bridge rectifier and current only pass one way into the panel meter. However, the neon must lit both ways.
- When proving with a DC source as with a H.V. Insulation tester, the poles must be tested for both polarity to confirm that the panel meter only show voltage in one way, but confirm that the neon indicates both polarity.
- The reading on the High Voltage Insulation tester also indicate the total value of the resistor chain and is also a good indication that the circuit is still correct and in good condition (See specifications).
- A **Proving Unit** can also be used if a High Voltage Insulation Meter is not available. The Proving unit does not indicate how many mega ohms are in the front end or if the circuit is still in good condition or not. The Proving unit only output a DC voltage of 5kVdc.

LIMIT MARK

- Each Phase Comparator has two poles.
- Each pole has a front end which is in Fiberglass tubing.
- Each pole has an Handle section.
- At the junction between the handle section and the front end section, there is a **RED BAND** which **is the limit mark**.
- By definition, this mark, or the **Red Band, indicates the physical limit to which the poles of the Phase Comparators may be inserted between live components or may touch them**.

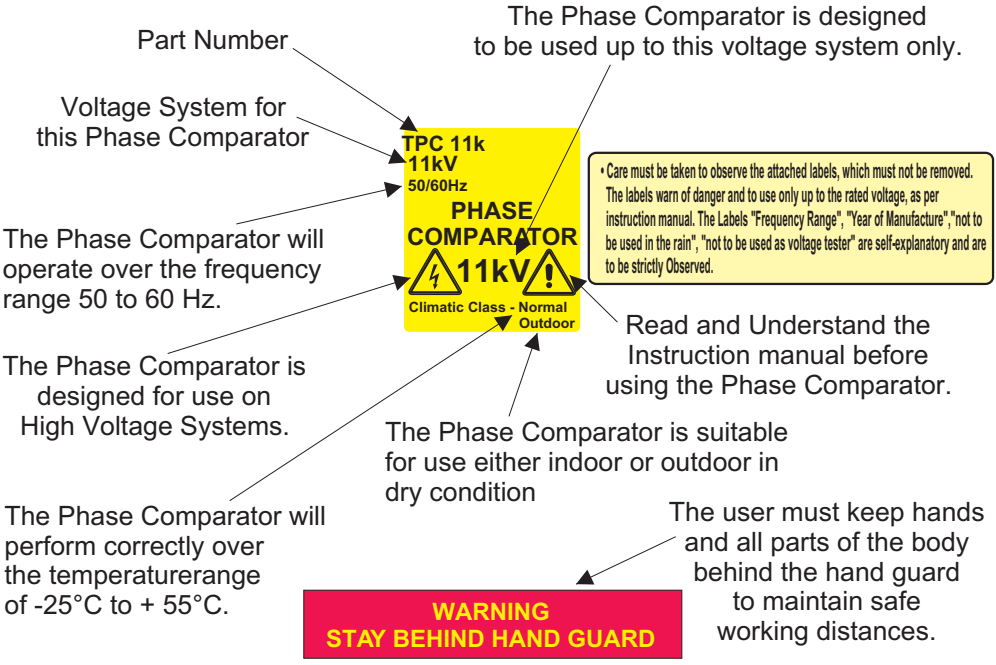
LABELS AND MARKING

- The following labels must be present on the Master Pole.



- The following labels must be present on BOTH Poles.

6.6kV
DANGER: USE ON SYSTEMS UP TO 6.6kV ONLY AS PER INSTRUCTION MANUAL
11kV
DANGER: USE ON SYSTEMS UP TO 11kV ONLY AS PER INSTRUCTION MANUAL
22kV
DANGER: USE ON SYSTEMS UP TO 22kV ONLY AS PER INSTRUCTION MANUAL
33kV
DANGER: USE ON SYSTEMS UP TO 33kV ONLY AS PER INSTRUCTION MANUAL
44kV
DANGER: USE ON SYSTEMS UP TO 44kV ONLY AS PER INSTRUCTION MANUAL


Part Number
Voltage System for this Phase Comparator
The Phase Comparator will operate over the frequency range 50 to 60 Hz.
The Phase Comparator is designed for use on High Voltage Systems.
The Phase Comparator will perform correctly over the temperaturerange of -25°C to + 55°C.
The Phase Comparator is designed to be used up to this voltage system only.
TPC 11k
11kV
50/60Hz
PHASE
COMPARATOR
11kV
Climatic Class - Normal
Outdoor
• Care must be taken to observe the attached labels, which must not be removed. The labels warn of danger and to use only up to the rated voltage, as per instruction manual. The Labels "Frequency Range", "Year of Manufacture","not to be used in the rain", "not to be used as voltage tester" are self-explanatory and are to be strictly Observed.
Read and Understand the Instruction manual before using the Phase Comparator.
The Phase Comparator is suitable for use either indoor or outdoor in dry condition
The user must keep hands and all parts of the body behind the hand guard to maintain safe working distances.
WARNING
STAY BEHIND HAND GUARD

RANGE OF MODELS

- Models are available to cover system voltages from 1kV to 44kV @50 or 60Hz.
- Contact the factory for information on models suitable for other voltages.
- The following models are available as standard instruments:

Model N°	System Voltage Voltage	Full Scale Voltage	Maximum Voltage	Display Type
TPC7k	6.6kV	8kV	9kV	Neon & Panel Meter
TPC11k	11kV	12kV	15kV	Neon & Panel Meter
TPC22k	22kV	24kV	30kV	Neon & Panel Meter
TPC33k	33kV	36kV	40kV	Neon & Panel Meter
TPC44k	44kV	48kV	55kV	Neon & Panel Meter

INSTRUCTION FOR USE

- Before using the Phase Comparator, clean the Front End (FiberGlass) with a polymer polishing.
- All models do not require batteries and are being signal driven (current taken from the source or circuit under test) and do not require arming. However, **it is recommended that a functional test be carried out using an High Voltage Insulation tester** or a proving unit.
- To prove the Phase Comparator, set the voltage on the Proving unit or on the High Voltage Insulation tester, to suit the model of Phase Comparator. Turn the test "ON" or the proving unit "ON". The Neon should lit (if the voltage if high enough) and the indicator should move nearest the voltage measured.
- Reverse the poles of the Phase Comparator and check that an out-of-phase indication is given.
- They are **no user serviceable parts** on our range of Phase Comparators. Should the Phase Comparator become damaged, faulty or, suspect in any form, please consult with your nearest distributor to return it to the factory.
- There must be galvanic contact between the test electrodes and the part of the installation under test and, no other part of the phase Comparator, except the electrodes, should be in contact with energized or earthed parts, in order to ensure accuracy of the display.

OPERATION

To determine the correct phase relationship between two energized conductors, the following procedure should be followed:

- First, **Check that each Phase to be compared is individually energized**.
  1. With one handle held in each hand, touch one bare conductor (first phase which will be compared later) with one contact electrode and touch the earth with the other contact electrode.
  2. The Neon will operate and the meter pointer will indicate the Red out-of-phase band indication which indicate that this phase is energized. The voltage scale will indicate the voltage phase -to-Earth or/and the percentage of the full scale.
  3. Repeat the operation 1 and 2 with the other bare conductor (the other phase to be compared later) so that it is known that both Conductors are energized.
- Now, you should know if both conductors are energized because you will have read the voltage Phase-to-Earth of both conductors.
- If both phases are not energized, then, the remedial action will have to be carried out before proceeding to the next stage of the Test.
- **Compare the Phases.**
- If both Phases are energized (after checking between Phase and Earth that they are energized) proceed to compare between the phases.
- Now touch each bare conductor (each phase to compare) with a contact Electrode.
- If the conductors (Phases) are **in-phase**, the **neon will not lit** and the **meter pointer will not operate** or the meter pointer **will stay in the Green** band.
- If the conductors (Phases) are **out-of-phase**, the **neon will lit** and the **meter pointer will operate** or the meter pointer **will go in the Red** band.

SPECIFICATIONS

Safety Standard
IEC 61481

	TPC7k	TPC11k	TPC22k	TPC33k	TPC44k
Total Resistance	4.48M ohm	6.78M ohm	10.82M ohm	19.68M ohm	26.8M ohm
Response time	<1Sec	<1Sec	<1Sec	<1Sec	<1Sec
Neon Threshold	1.2kV	1.2kV	1.2kV	1.2kV	1.2kV
Neon Lit Fully @	1.5kV	1.5kV	1.5kV	1.5kV	1.5kV

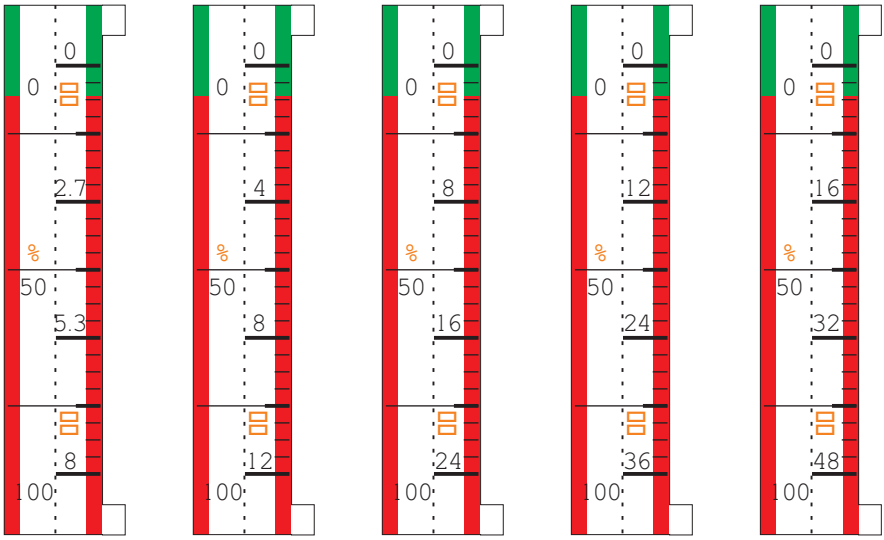
Mechanical

	TPC7k	TPC11k	TPC22k	TPC33k	TPC44k
Lenght of Handle	775mm	775mm	775mm	775mm	775mm
Lenght of Front End (Fiberglass)	400mm	400mm	500mm	665mm	820mm
Total Lenght	1.175M	1.175M	1.275M	1.440M	1.595M
Total Weight	2.1kG	2.1kG	2.2kG	2.4kG	2.5kG
Handle Material	Composite Material with Polyurethane				
Front End	Fiber Glass Wound Tubing				

Vibration Resistance: tested in accordance with IEC 68-2-6
Drop Resistance: tested in accordance with IEC 68-2-32
Bump: tested in accordance with IEC 68-2-2
Impact: tested in accordance with IEC 1010 Clause 8.2
Deflection: the contact electrodes must not deflect by more than 150mm when loaded at the electrode by 10N.
Connection Lead.Cord Strenght: each pole connection to withstand 10000 swing with 10N Load applied and a vertical pull with 200N applied.

Environmental
Operating temperature:-25°C to +55°C
Operating Humidity: 20 to 96% RH.

SCALES



TPC 7k TPC 11k TPC 22k TPC 33k TPC 44k

Special Scales and configuration can be manufactured on a case by case basis. Contact the factory with your requirements.

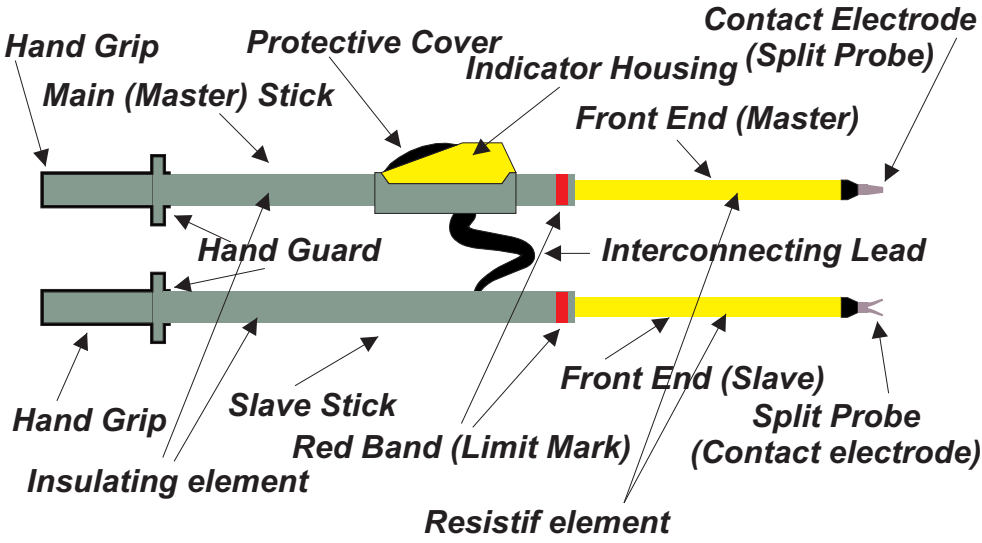
DIRECTIONS FOR USE

It is the user's responsibility to ensure that only competent personnel, with the necessary knowledge and training to work with high voltage, use and handle this equipment.

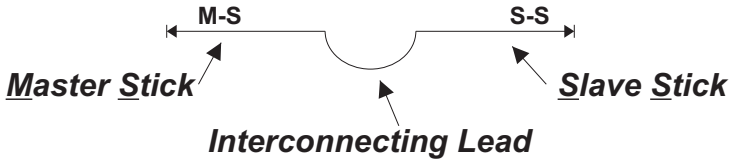
Before using the Phase Comparators, it is recommended to check them with an High Voltage Insulation tester (if possible a variable one).

For Phasing, it must be ensured that both feeders are in a live condition, of the same voltage and in a stable state, before commencing the phasing tests.

The Phase Comparators comprises of two interconnected parts; these are the Master Stick, containing the indicator housing. The second stick is referred to as the slave.

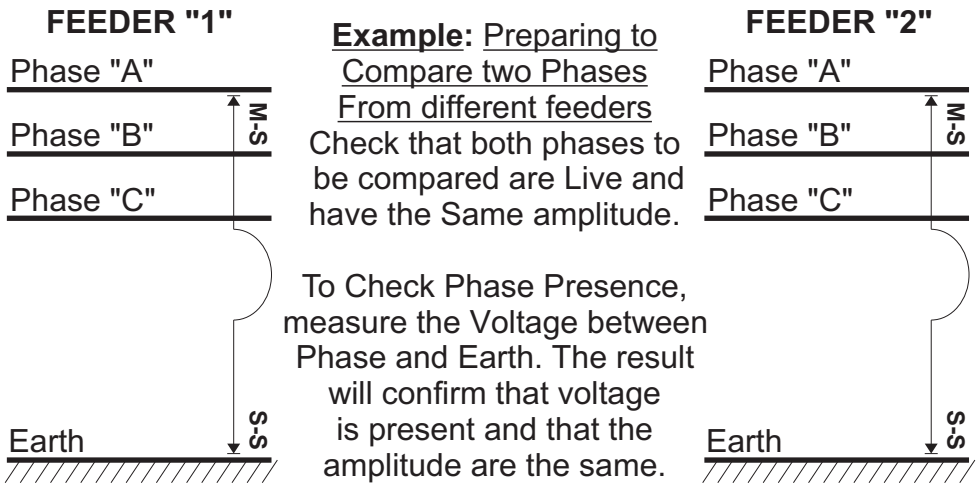


REPRESENTATION FOR EXPLANATION PURPOSE



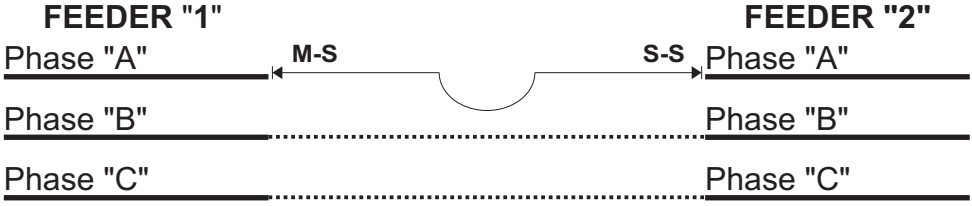
TESTING FOR PHASE PRESENCE

Before doing the Phase Comparison test, you must ensure that the feeders to be compared are live.

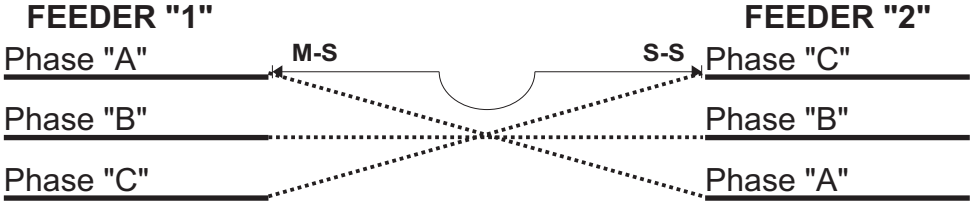

FEEDER "1"
Phase "A"
Phase "B"
Phase "C"
M-S
S-S
Earth
Example: Preparing to Compare two Phases From different feeders
Check that both phases to be compared are Live and have the Same amplitude.
To Check Phase Presence, measure the Voltage between Phase and Earth. The result will confirm that voltage is present and that the amplitude are the same.
FEEDER "2"
Phase "A"
Phase "B"
Phase "C"
M-S
S-S
Earth

TESTING FOR PHASING

No Indication - Neon OFF (does not lit) = IN PHASE



Indication - Neon ON (does lit) = OUT OF PHASE



Note that the links must be arranged so that the phases are Connected in Phase, as indicated by the dotted lines.

Do Not Use Phasing Sticks unless you have been fully trained In High Voltage work and understand the system fully.

CARE AND MAINTENANCE

- ***Storage***: The Phase Comparator and it's accessories should be stored in the proprietary carrying case/bag when not in use.

- ***Transporting***: When the equipment is in transit it should be stored in its carrying case/bag. Whilst the equipment has been designed for field use it should not be subjected to excessive bumps and shocks.

- ***Cleanliness***: Dirt can cause surface tracking and it's therefore necessary to keep the Phase Comparator and its accessories clean by washing them in mild detergent solution. All part should be cleaned with the appropriate liquid.

- ***Mechanical Damage***: If surface scratches or dents can easily be seen by the naked eye, then the equipment should be returned to the factory of your nearest distributor for repairs since these blemishes act as traps for dirt and moisture. Mechanical damage would also necessitate the return of the equipment to the manufacturer.

- ***Recelebration and Proof Testing***: Every twelve months the Phase Comparator and it's accessories should be rechecked. This would include checking the threshold level of the neon, voltage proof testing in factory or accredited laboratory and pressure testing of the panel meter housing.

Please note that there are no internal user replaceable parts.

The Phase comparator must always be clean and dry before use and during use. Please store the Phase Comparator in a dry Place.

LIMITED WARRANTY

We warrant the product manufactured by us to be free from defective material or factory workmanship and agree to repair or replace this product which, under normal use and service, disclose the defect to be the fault of our manufacturing, with no charge for parts and service.
If we are unable to repair or replace this product, we will make a full refund of the purchase price. Consult the user's manual for proper instruction regarding use of this instrument. Our obligation under this warranty is limited to repairing, replacing or making refund of this test equipment which proves to be defective within forty eight months from the date of purchase.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons in any way so as, in our sole judgement, to injure their stability or reliability, or which have been subject to misuse, abuse, misapplication, negligence or accident or which have had the serial numbers altered, defaced or removed.

All warranties implied by law are hereby limited to a period of fourty eight months, and the provisions of the warranty are expressly in lieu of any other warranties expressed or implied.

The purchaser agrees to assume all liability for any damages or bodily injury which may result from the use or misuse of the product by the purchaser, or it's user, his employees, or others, and the remedies provided for in this warranty are expressly in lieu of any other liability we may have including incidental or consequential damages.

We reserve the right to discontinue models at any time, or change specification, price or design, without notice and without incuring Any obligation.

NOTES

We Exceeded the safety specifications wherever possible. However, we can't be held liable for misuse or bad manipulation.
We simplified the Phase Comparators by not having any parts to assemble on site. There is no user serviceable parts or user assembled part in our Phase Comparators.
Only the tip (contact electrode) has to be screwed on the Front end of each pole. They generally do not need to be removed by the user. For other kind of tips and contact electrodes, contact the factory or you nearest distributor.
Getting regular training on your High Voltage equipment and on the electrical network / grid you are working on is a good practice and will help in keeping you safe.
Always make a sketch before proceeding with testing High Voltage and ensure you are fully in control of the testing and understand Fully what is going on. Failure to do so can result in fatal accidents.